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Europäisches Patentamt
European Patent Office
Office européen des brevets



11 Publication number:

0 555 480 A1

12

EUROPEAN PATENT APPLICATION
published in accordance with Art.
158(3) EPC

21 Application number: **91917803.8**

22 Date of filing: **18.10.91**

86 International application number:
PCT/JP91/01428

87 International publication number:
WO 92/07849 (14.05.92 92/11)

51 Int. Cl.⁵: **C07D 417/06, C07D 513/04,
A61K 31/425, A61K 31/44,
A61K 31/445**

30 Priority: **24.10.90 JP 286902/90**

43 Date of publication of application:
18.08.93 Bulletin 93/33

84 Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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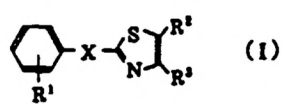
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54 **NOVEL THIAZOLE DERIVATIVE.**

57 A novel thiazole derivative represented by general formula (I), which has a selective agonistic activity for 5-HT₃ receptor, a pharmaceutical composition thereof, and a process for producing the same. In the said formula, R¹ represents hydrogen or lower alkoxy; R² and R³ are such that R² represents hydrogen and R³ represents a group, -Y-Het, wherein Y represents a single bond or lower alkylene and Het represents a nitrogenous heterocyclic group, or alternatively R² and R³ are combined together to form a group, -(CH₂)_m-NR⁴-(CH₂)_n-, wherein m and n are each 1 or 2 and R⁴ represents lower alkyl; and X represents -NH-, -NHC(=O)NH-, -C(=O)-NH- or -NHC(=O)-.

USPN: 10/634,162
ART UNIT: 1625
FILED: AUGUST 5, 2003
INVENTOR: WILSON

EP 0 555 480 A1



TECHNICAL FIELD

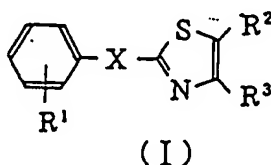
The present invention relates to novel thiazole derivatives and pharmaceutically acceptable salts thereof having 5-HT₃ receptor agonist activity, pharmaceutical compositions thereof, and processes for producing the same.

BACKGROUND ART

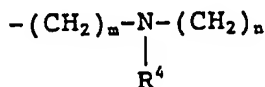
While it is acknowledged that, roughly classified, there are 4 types of serotonin (5-HT) receptors, the neuronal serotonin (5-HT) receptors located in the primary afferent nerves of the enteric nervous system or of the central nervous system are considered, as of this day, to be 5-HT₃ receptors. Regarding such 5-HT₃ receptors, many compounds having 5-HT₃ receptor antagonist activity have so far been discovered. For example, the compounds described in British Patents 2,125,398, 2,166,726, 2,126,728 and 2,153,821 are known to have such activity. However, there has not been discovered a compound having selective 5-HT₃ receptor agonist activity.

DISCLOSURE OF INVENTION

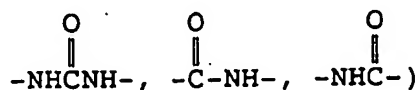
The inventors of the present invention conducted extensive studies regarding 5-HT₃ receptors, created a variety of compounds and subjected them to a screening. As a result, they discovered that a novel thiazole derivative of the following general formula (I) possesses excellent selective 5-HT₃ receptor agonist activity and accomplished the present invention. The thiazole derivative of the general formula (I) exhibits its action by inducing release of acetylcholine from the afferent nerve endings. It is thought that any 5-HT₃ receptor agonist drug will be useful particularly in disorders of the digestive system.



(wherein R¹ means a hydrogen atom or a lower alkoxy group, R² and R³ are either such that R² means a hydrogen atom and R³ means a group of the formula -Y-Het (where Y means a single bond or a lower alkylene group and Het means a nitrogen-containing heterocyclic group) or such that R² and R³ combined together mean a group of the formula



(where m and n each means 1 or 2 and R⁴ means a lower alkyl group), and X means a group represented by one of the following formulas: -NH-,



It is, therefore, an object of the present invention to provide a thiazole derivative of the above general formula (I) or a pharmaceutically acceptable salt thereof.

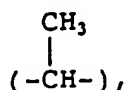
Another object of the present invention is to provide a pharmaceutical composition comprising aforementioned derivative or salt, and a pharmaceutically acceptable carrier.

It is still another object of the present invention to provide processes for producing the aforementioned derivative or salt.

The compound of the above general formula (I) is now described in further detail.

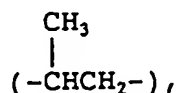
Throughout this specification, the term "lower" means, unless otherwise indicated, a straight or
5 branched carbon chain containing 1 to 6 carbon atoms.

Thus, the "lower alkyl group" includes methyl, ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl, tert-butyl, pentyl, isopentyl, hexyl, isohexyl and so on. The group meant by "lower alkoxy group" includes methoxy, ethoxy, propoxy, isopropoxy, butoxy, isobutoxy, sec-butoxy, tert-butoxy, pentyloxy, isopentyloxy, hexyloxy, isohexyloxy and so on. Furthermore, "lower alkylene group" includes methylene, ethylene,
10 methylenemethylene



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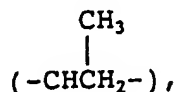
trimethylene, 1-methylethylene



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2-methylethylene

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tetramethylene, 1-methyltrimethylene, 2-methyltrimethylene, 1-ethylethylene, 2-ethylethylene, pentamethylene, 1-methyltetramethylene, 2-methyltetramethylene, 3-methyltetramethylene, 4-methyltetramethylene, hexamethylene and so on.

Moreover, the nitrogen-containing heterocyclic group forming R³ means a 5- to 6-membered
35 heterocyclic group containing 1 nitrogen atom. Representative species of the heterocyclic group are pyrrolidinyl, pyrrolyl, piperidyl, pyridyl and so on.

The compound of the present invention contains double bonds and may contain asymmetric carbon atoms depending on substituent groups. Therefore, the compound of the present invention include various mixtures of isomers and individual isomers, such as geometrical isomers, tautomers and optical isomers.

40 The compound (I) of the present invention may form acid addition salts. Among specific such salts are addition salts with mineral acids such as hydrochloric acid, hydrobromic acid, hydroiodic acid, sulfuric acid, nitric acid, phosphoric acid, etc., organic acids such as formic acid, acetic acid, propionic acid, oxalic acid, malonic acid, succinic acid, fumaric acid, maleic acid, lactic acid, malic acid, tartaric acid, citric acid, methanesulfonic acid, ethanesulfonic acid, etc. and acidic amino acids such as aspartic acid, glutamic acid,
45 etc.

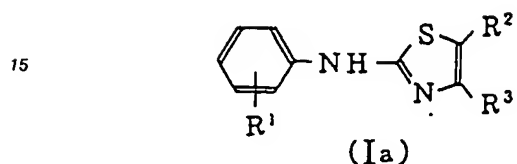
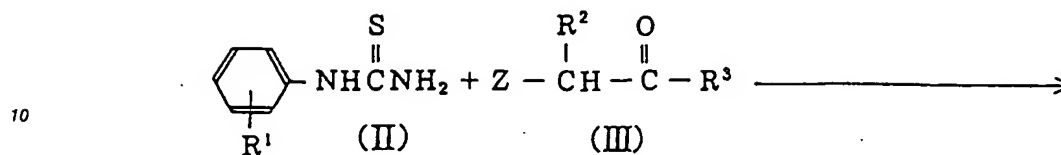
Production Processes

The compound and salt of the present invention can be produced by application of a variety of
50 synthetic processes utilizing the respective features of their skeletal structures or substituent groups. Some representative processes are now described below by way of example.

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Process 1

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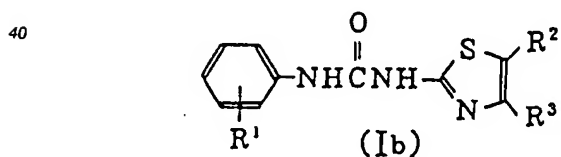
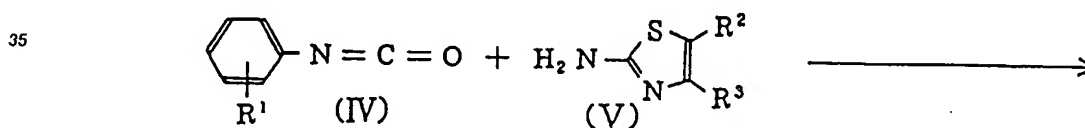
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(wherein R¹, R² and R³ have the meanings respectively defined hereinbefore and Z means a halogen atom such as Cl and Br)

This production process comprises reacting a thiourea derivative of the general formula (II) with an α-halogenoketone derivative of the general formula (III) to synthesize a thiazole derivative of the general formula (Ia). This reaction is, for example, conducted in a solvent such as alcohol, acetone, ether, tetrahydrofuran, diglyme, dioxane, etc. at room temperature or under warming.

Production Process 2

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(wherein R¹, R² and R³ have the meanings respectively defined hereinbefore)

This production process comprises reacting an isocyanate derivative of the general formula (IV) with an amine compound of the general formula (V) to synthesize an urea derivative of the general formula (Ib). This reaction is generally conducted in a solvent such as chloroform, dichloromethane, 1,2-dichloroethane, ether, tetrahydrofuran, acetone, etc., under cooling or at room temperature.

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This production process comprises reacting a carboxylic acid derivative of the general formula (VI) with an amine derivative of the general formula (V) to synthesize an amide derivative of the general formula (Ic). This reaction is generally conducted using an activating agent of a carboxylic acid, such as ethyl chlorocarbonate or, dicyclohexylcarbodiimide (DCC) and 1-hydroxybenzotriazole (HOBT), in a solvent such as methylene chloride, chloroform, 1,2-dichloroethane, dimethylformamide, etc. under cooling or at room temperature.

Production Process 4

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This process comprises reacting an amine derivative of the general formula (VII) with a carboxylic acid derivative of the general formula (VIII) to synthesize an amide derivative of the general formula (Id).

This process is carried out in the same manner as Production Process 3.

55 INDUSTRIAL APPLICABILITY

By acting specifically on the neuronal 5-HT₃ receptors located in the enteric nervous system, the compounds of the present invention are useful for the treatment of disorders of the digestive system,

namely senile constipation, atonic constipation, diabetic motor disorder of the digestive tract, postoperative motor disorder of the digestive tract, retention of gastric contents, dyspepsia, flatulence and so on.

Furthermore, since the compound of the present invention shows a behavior analogous to that of 5-HT toward the inhibitory presynaptic 5-HT₃ receptors located in the central nervous system, it is useful for the treatment of such symptoms as mental disorders (for example, schizophrenia and depression), anxiety and dysmnnesia. In addition, it is foreseen that through activation of dopaminergic neurons in the central nervous system, it may find application in improving extrapyramidal symptoms (particularly parkinsonism).

The pharmacologic actions of the compound of the present invention were confirmed by the following methods (Bezold-Jarisch reflex in anesthetized rat).

Male Wistar rats, 9 weeks old, were anesthetized with urethane 1 g/kg i.p. and the blood pressure and the heart rate were determined under artificial ventilation. The transient decreases in heart rate and blood pressure that were induced by intravenous administration of the compound of the present invention were evaluated as indicators of 5-HT₃ receptor-mediated responses (Bezold-Jarisch reflex; Paintal. A. S., *Physiol. Rev.*, 53, 159 (1973)) and compared with the responses to serotonin and 2-methylserotonin which is a selective 5-HT₃ agonist. In addition, it was confirmed by using 5-HT₃ receptor antagonists that the changes caused by administration of the compound of the present invention were 5-HT₃ receptor-mediated responses.

1) 5-HT₃ receptor stimulating action (Bezold-Jarisch reflex evoking action)

The compound and salt of the present invention, given intravenously (0.3-30 µg/kg), depressed the heart rate and blood pressure dose-dependently and these effects were more prominent than those of serotonin or 2-methylserotonin which is a selective 5-HT₃ agonist. The Bezold-Jarisch (BJ) reflex evoking action of the compound of the present invention in rats is shown in the following table.

The compound of Example 1 was about 5-fold as potent as serotonin in the above-mentioned Bezold-Jarisch reflex evoking activity.

	BJ reflex evoking activity	
	ED ₅₀ (µg/kg i.v.)	E _{max} (beats/min) (maximal brady-cardiac response)
Compound of Example 1	3.01	205.8
Serotonin	15.6	257.9
2-Methylserotonin	37.4	259.0

2) Effects of 5-HT₃ receptor antagonists on the action of the compound of the present invention

The decreases in heart rate and blood pressure as induced by the compound of the present invention were competitively inhibited by administering a 5-HT₃ receptor antagonist, viz. GR38032F (30 µg/kg i.v.) or ICS 205-930 (0.1-1 µg/kg i.v.), 10 minutes before administration of the compound of the present invention.

The above results 1) and 2) indicate that the compound of the present invention is a potent and selective 5-HT₃ receptor agonist.

The compound of the present invention is sparingly toxic, with an acute toxicity value (the up and down method) of 50 to 100 mg/kg i.v. for male mice.

The pharmaceutical composition containing one or more species of the compound and salt of the present invention as the active ingredient is formulated with the conventional pharmaceutical carrier, excipient and/or other additives, into tablets, powders, fine granules, capsules, pills, solutions, injections, suppositories, ointments, plasters, etc., and administered orally (inclusive of sublingual administration) or parenterally.

The pharmaceutical carrier or excipient includes a variety of solid or liquid nontoxic substances for pharmaceutical use. Among them are lactose, magnesium stearate, starch, talc, gelatin, agar, pectin, gum arabic, olive oil, sesame oil, cacao butter, ethylene glycol and other substances which are commonly employed.

The clinical dosage of the compound of the present invention is appropriately determined according to the condition, body weight, age, sex, and other factors of the patient being treated, but generally the daily dosage for the adult human is 0.2 to 2 mg for intravenous injection or 1 to 10 mg for oral administration, to be administered in a single dose or in a few divided doses.

FORMULATION EXAMPLES

The following are typical pharmaceutical formulation examples for the compound of the present invention.

(1) Tablets

Compound of Example 1 (hereinafter referred to as compound A)	0.2 mg
Lactose	106.4 mg
Corn starch	48.0 mg
Hydroxypropylcellulose	4.8 mg
Magnesium stearate	0.6 mg
	160.0 mg/tablet

First, 200 mg of compound A, 106.4 g of lactose and 48 g of corn starch are evenly blended and, after adding 48 ml of a 10% aqueous solution of hydroxypropylcellulose, the mixture is granulated using a granulating machine. Then, 0.6 g of magnesium stearate is added to the granules and the whole mixture is compression-molded to provide tablets each weighing 160 mg (1000 tablets).

(2) Powders

Compound A	0.4 mg
Mannit	770.0 mg
Corn starch	199.6 mg
Polyvinylpyrrolidone	30.0 mg
	1000.0 mg

First, 0.4 g of compound A, 770 g of mannitol and 199.6 g of corn starch are evenly blended and, then, 300 ml of a 10% aqueous solution of polyvinylpyrrolidone is added. The mixture is then granulated using a granulation machine to provide powders (1 kg).

(3) Capsules

Compound A	0.2 mg
Corn starch	198.8 mg
Calcium stearate	1.0 mg
	200.0 mg

First, 0.2 g of compound A, 198.8 g of corn starch and 1 g of calcium stearate are evenly blended and the mixture is filled in 200 mg portions into No. 3 capsule shells to provide capsules (1000 capsules).

(4) Syrup

Compound A	0.2 mg
Sucrose	8.0 mg
Water to make	5 ml

A syrup is prepared by dissolving 0.2 g of compound A and 8 g of sucrose in sufficient pure water to make 5 l.

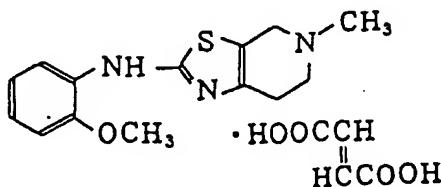
(5) Injectable solution for intravenous administration

Compound A	0.3 mg
Sodium chloride	9 mg
Distilled water for injection to make	1.0 ml

First, 300 mg of compound A and 9 g of sodium chloride are dissolved in sufficient distilled water for injection use to make 1000 ml. After filtration, this solution is filled in 1 ml portions into ampuls to provide injections. In the process, air in each ampul is replaced with nitrogen gas. The ampuls are then heat-sterilized by autoclaving (1000 ampuls).

EXAMPLES

The following examples are intended to describe the present invention in further detail.

Example 1

(1) To 50 ml of acetone were added 2.46 g of o-anisidine and 3.75 g of benzoyl isothiocyanate, and the mixture is stirred under reflux for 2 hours and, then, allowed to stand overnight in a refrigerator at 5 °C. The resulting crystals were collected by filtration, washed with cold acetone and dried under reduced pressure. The crystals were added to 50 ml of 30% methylamine-methanol and the mixture was stirred at room temperature overnight. The reaction mixture was concentrated to dryness under reduced pressure, and the residue was washed with ethanol-ethyl acetate and dried under reduced pressure. The procedure provided 2.08 g of N-(o-methoxyphenyl)thiourea.

Physicochemical properties:

¹H Nuclear magnetic resonance spectrum (6, DMSO-d₆):

3.84 (s, 3H), 6.80-7.24 (m, 3H), 7.76-7.88 (dd, 1H)

Mass spectrum (FAB): m/z 183 (M⁺ + 1)

(2) To 2 ml of ethanol were added 0.6 g of 3-bromo-1-methylpiperidin-4-one hydrobromide and 0.37 g of the compound synthesized in (1) and the mixture was stirred at 80 °C for 30 minutes. The mixture was then concentrated to dryness under reduced pressure, and the residue was diluted with aqueous sodium hydrogencarbonate solution and extracted with ether. The extract was dried over anhydrous magnesium sulfate and concentrated to dryness under reduced pressure. The residue was treated with a suitable amount of fumaric acid in methanol-acetonitrile and the resulting crystals were collected by filtration to provide 0.25 g of 2-(o-methoxyanilino)-5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridine fumarate.

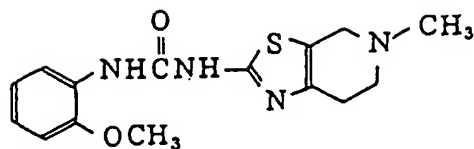
Physicochemical properties:

Melting point: 185-190 °C (decomp.)

Elemental analysis (for C ₁₄ H ₁₇ N ₃ OS·C ₄ H ₄ O ₄ ·0.6H ₂ O):			
	C(%)	H(%)	N(%)
Calcd.	53.76	5.56	10.45
Found	53.75	5.53	10.53

Mass spectrum (EI): m/z 275 (M⁺, free compound)

Example 2



(1) To 11 ml of ethanol were added 0.86 g of thiourea and 3.08 g of 3-bromo-1-methylpiperidin-4-one hydrobromide, and the mixture was stirred under reflux for 1 hour. The reaction mixture was then concentrated to dryness under reduced pressure, and the residue was diluted with aqueous sodium carbonate solution and extracted with dichloromethane.

The organic layer was concentrated to dryness under reduced pressure and subjected to column chromatography (silica gel; chloroform-methanol) to provide 0.56 g of 2-amino-5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridine as powders.

Physicochemical properties:

¹H Nuclear magnetic resonance spectrum (δ , CDCl₃):

2.50 (s, 3H), 2.60-2.80 (m, 4H), 3.40-3.50 (m, 2H)

Mass spectrum (EI): m/z 169 (M⁺)

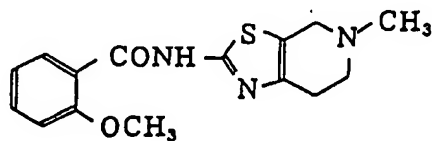
(2) To 5 ml of dichloromethane were added 0.17 g of the compound obtained in (1) and 0.15 g of (o-methoxyphenyl) isocyanate and the mixture was stirred at room temperature overnight. The reaction mixture was then concentrated to dryness under reduced pressure, subjected to column chromatography (silica gel; chloroform-methanol) and washed with ethyl acetate. This procedure provided 0.25 g of N-(o-methoxyphenyl)-N'-(5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridin-2-yl)urea melting at 201-203 °C.

Physicochemical properties:

Elemental analysis (for C ₁₅ H ₁₈ N ₄ O ₂ S):				
	C(%)	H(%)	N(%)	S(%)
Calcd.	56.58	5.70	17.60	10.07
Found	56.38	5.64	17.46	10.14

Mass spectrum (EI): m/z 318 (M⁺)

Example 3



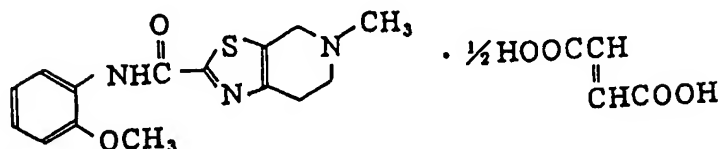
To a solution of 0.15 g of o-methoxybenzoic acid in 2 ml of DMF was added 0.16 g of HOBt followed by addition of 0.25 g of DCC. After 30 minutes, 0.17 g of the compound obtained in Example 2-(1) was added and the mixture was stirred at room temperature overnight. The reaction mixture was then poured in ethyl acetate-water and the insolubles were filtered off. After phase separation, the aqueous layer was extracted with chloroform. The organic layers were combined and concentrated to dryness under reduced pressure, and the residue was subjected to column chromatography (silica gel; chloroform-methanol) and washed with ether-isopropyl ether to provide 0.14 g of N-(5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridin-2-yl)-o-methoxybenzamide melting at 164-166 °C.

Physicochemical properties:

Elemental analysis (for $C_{15}H_{17}N_3O_2S \cdot 0.4H_2O$):				
	C(%)	H(%)	N(%)	S(%)
Calcd.	58.01	5.78	13.53	10.32
Found	58.05	5.51	13.37	10.35

Mass spectrum (EI): m/z 303 (M^+)

Example 4



(1) To 8 ml of water were added 1.02 g of the compound obtained in Example 2-(1), 1.14 g of cuprous bromide and 5.1 ml of 48% aqueous hydrogen bromide solution. To this solution, 0.62 g of sodium nitrite was added in small portions at -5°C . The temperature was increased to 20°C over a period of 30 minutes, and the reaction mixture was neutralized with sodium hydrogencarbonate and extracted with chloroform. The extract was concentrated to dryness under reduced pressure and purified by column chromatography (silica gel; chloroform-methanol) to provide 0.96 g of 2-bromo-5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridine.

Physicochemical properties:

^1H Nuclear magnetic resonance spectrum (δ , CDCl_3):

2.50 (s, 3H), 2.8-3.0 (m, 4H), 3.55-3.75 (m, 2H)

Mass spectrum (EI): m/z 232, 234 (M^+)

(2) In an argon stream, 4.5 ml of 15% n-butyllithium-hexane was added to 80 ml of dry ether at -60°C . At -70°C , a solution of 0.95 g of the compound obtained in (1) in 15 ml of dry ether was added dropwise over a period of 1 hour. This solution was dripped onto dry ice in dry ether and, 30 minutes later, hydrogen chloride-ethyl acetate was added. The resulting solution was concentrated to dryness under reduced pressure and a portion thereof (0.59 g) was added to 5 ml of DMF. Then, 0.25 g of triethylamine, 0.24 g of HOST and 0.37 g of DCC were serially added. Finally, 0.22 g of anisidine was added and the mixture was stirred at room temperature overnight.

The reaction mixture was poured in water and extracted with chloroform. The organic layer was concentrated to dryness under reduced pressure. The residue was purified by column chromatography (silica gel; chloroform-methanol) and treated with a suitable amount of fumaric acid in methanol to provide 0.17 g of N-(o-methoxyphenyl)-5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridine-2-carboxamide hemi-fumarate.

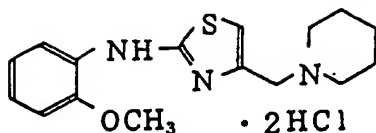
Physicochemical properties:

Melting point: $196-198^\circ\text{C}$

Elemental analysis (for $C_{15}H_{17}N_3O_2S \cdot 1/2C_4H_4O_4$):				
	C(%)	H(%)	N(%)	S(%)
Calcd.	56.50	5.30	11.63	8.87
Found	57.04	5.72	11.56	8.51

Mass spectrum (EI): m/z 303 (M^+ , free compound)

Example 5



In 40 ml of acetone, 4.0 g of 1-(o-methoxyphenyl)-thiourea and 3.0 g of dichloroacetone were stirred together at room temperature for 2 days. The resulting crystals were recovered by filtration and dissolved in 60 ml of ethanol containing 9.3 g of piperidine. Then, the solution was stirred at room temperature for 20

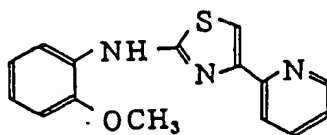
hours. The solvent was distilled off under reduced pressure, and the residue was diluted with water, made basic with potassium carbonate and extracted with ether. The ether layer was dried over anhydrous magnesium sulfate and concentrated under reduced pressure, and the residue was treated with hydrochloric acid and recrystallized from ethanol to provide 6.3 g of 2-(o-methoxyanilino)-4-piperidinomethylthiazole dihydrochloride.

Physicochemical properties:

Melting point: 166-169 °C

Elemental analysis (for $C_{16}H_{23}N_3OSCl_2$):						
	C(%)	H(%)	N(%)	O(%)	S(%)	Cl(%)
Calcd.	51.06	6.16	11.17	4.25	8.52	18.84
Found	51.08	6.20	11.12		8.48	18.80

Example 6



In 20 ml of ethanol, 0.5 g of 1-(o-ortho-methoxyphenyl)thiourea and 0.77 g of 2-bromoacetylpyridine hydrobromide were refluxed together for 1 hour. The solvent was then distilled off under reduced pressure, and the residue was diluted with water, made basic with potassium carbonate and extracted with ethyl acetate.

The ethyl acetate layer was dried over anhydrous magnesium sulfate and concentrated under reduced pressure, and the residue was recrystallized from ethanol to provide 0.71 g of 2-(o-methoxyanilino)-4-(2-pyridyl)thiazole.

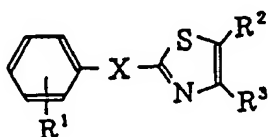
Physicochemical properties:

Melting point: 165-166 °C

Elemental analysis (for C ₁₅ H ₁₃ N ₃ OS):				
	C(%)	H(%)	N(%)	S(%)
Calcd.	63.58	4.62	14.83	11.32
Found	63.66	4.60	14.90	11.26

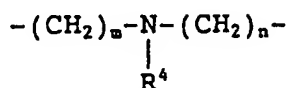
Claims

1. A thiazole derivative of the general formula (I):

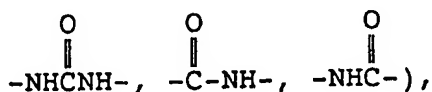


(I)

(wherein R¹ means a hydrogen atom or a lower alkoxy group, R² and R³ are either such that R² means a hydrogen atom and R³ means a group of the formula -Y-Het (where Y means a single bond or a lower alkylene group and Het means a nitrogen-containing heterocyclic group) or such that R² and R³ combined together mean a group of the formula

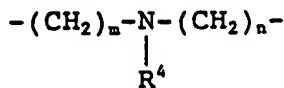


(where m and n each means 1 or 2 and R⁴ means a lower alkyl group), and X means a group represented by one of the formulas: -NH-,

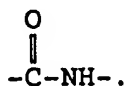


or a pharmaceutically acceptable salt thereof.

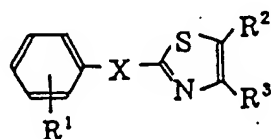
2. The compound or a pharmaceutically acceptable salt thereof as claimed in claim 1, wherein R¹ is a lower alkoxy group, R² and R³ combined together is a group of the formula



(wherein m and n each means 1 or 2 and R⁴ means a lower alkyl group), and X is a group of the formula -NH- or the formula

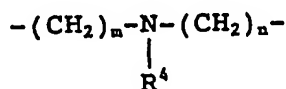


3. 2-(o-Methoxyanilino)-5-methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridine fumarate.
4. N-(5-Methyl-4,5,6,7-tetrahydrothiazolo[4,5-c]pyridin-2-yl)-o-methoxybenzamide.
5. A pharmaceutical composition comprising a pharmacologically effective amount of the thiazole derivative (I) or a pharmaceutically acceptable salt thereof as claimed in claim 1 and a pharmaceutically acceptable carrier.
6. A method for treating senile constipation, atonic constipation, diabetic motor disorder of the digestive tract, postoperative motor disorder of the digestive tract, retention of gastric contents, dyspepsia, flatulence, mental disorder such as schizophrenia and depression, anxiety and/or dysmnnesia which comprises administering a therapeutically effective amount of the pharmaceutical composition as claimed in claim 5 to a patient.
7. A method for producing a thiazole derivative of the general formula (I):

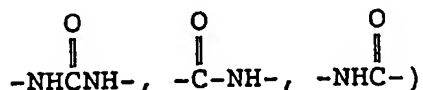


(I)

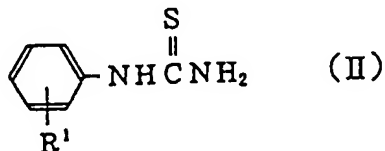
(wherein R¹ means a hydrogen atom or a lower alkoxy group, R² and R³ are either such that R² means a hydrogen atom and R³ means a group of the formula -Y-Het (where Y means a single bond or a lower alkylene group and Het means a nitrogen-containing heterocyclic group) or such that R² and R³ combined together mean a group of the formula



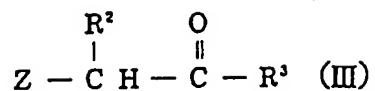
(where m and n each means 1 or 2 and R⁴ means a lower alkyl group), and X means a group represented by one of the formulas: -NH-,



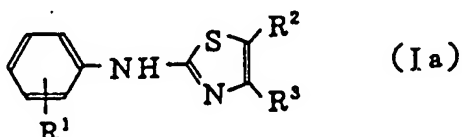
or a pharmaceutically acceptable salt thereof, comprising
(a) reacting a thiourea derivative of the general formula (II):



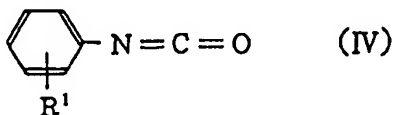
(wherein R¹ has the meaning defined above) with an α-halogenoketone derivative of the general formula (III):



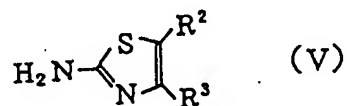
(wherein R^2 and R^3 have the meanings respectively defined above, and Z means a halogen atom) to give a thiazole derivative of the general formula (Ia):



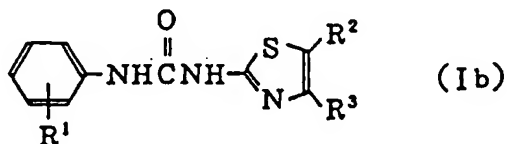
(wherein R^1 , R^2 and R^3 have the meanings respectively defined above); or
(b) reacting an isocyanate derivative of the general formula (IV):



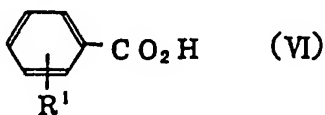
(wherein R^1 has the meaning defined above) with an amine derivative of the general formula (V):



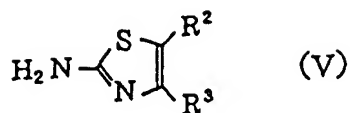
(wherein R^2 and R^3 have the meanings respectively defined above) to give an urea derivative of the general formula (Ib):



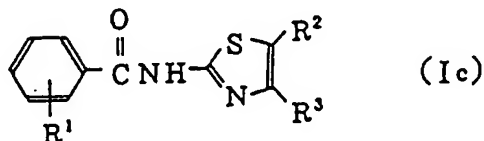
(wherein R^1 , R^2 and R^3 have the meanings respectively defined above); or
(c) reacting a carboxylic acid derivative of the general formula (VI):



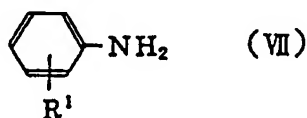
(wherein R^1 has the meaning defined above) with an amine derivative of the general formula (V):



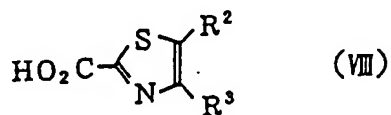
(wherein R^2 and R^3 have the meanings respectively defined above) to give an amide derivative of the general formula (Ic):



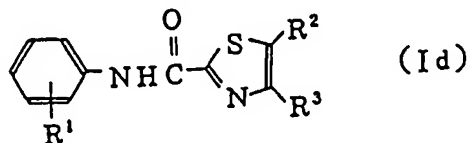
(wherein R^1 , R^2 and R^3 have the meanings respectively defined above); or
(d) reacting an amine derivative of the general formula (VII):



(wherein R^1 has the meaning defined above) with a carboxylic acid derivative of the general formula (VIII):



(wherein R^2 and R^3 have the meanings respectively defined above) to give an amide derivative of the general formula (Id):



(wherein R^1 , R^2 and R^3 have the meanings respectively defined above).

INTERNATIONAL SEARCH REPORT

International Application No. PCT/JP91/01428

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. ⁵ C07D417/06, C07D513/04, A61K31/425, A61K31/44, A61K31/445		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	C07D417/06, C07D513/04, A61K31/425, A61K31/44, A61K31/445	
Documentation Searched other than Minimum Documentation to the extent that such documents are included in the fields searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	DE, A, 3428342 (Boehringer Ingelheim Vetmedica G.m.b.H., Fed. Rep. Ger.), February 13, 1986 (13. 02. 86) & JP, A, 61-56047 & EP, A, 170193 & US, A, 4853402 & AU, A, 4575385 Compound of formula III	1-2, 7
A	DE, A, 3820775 (THOMAE K GMBH), December 21, 1989 (21. 12. 89) & EP, A, 347766 & JP, A, 2-45489 & AU, A, 8936593	1-5, 7
A	JP, A, 59-141554 (SOGO YAKKO KK), August 14, 1984 (14. 08. 84), (Family: none)	1-5, 7
A	EP, A, 117082 (FUJISAWA PHARM KK), August 29, 1984 (29. 08. 84) & JP, A, 59-193878 & US, A, 4649146	1-5, 7
A	DE, A, 3332148 (KOTOBUKI SEIYAKU CO.), May 24, 1984 (24. 05. 84) & JP, A, 59-95281 & FR, A, 2536399	1-5, 7
<p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"Z" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
December 5, 1991 (05. 12. 91)	January 14, 1992 (14. 01. 92)	
International Searching Authority	Signature of Authorized Officer	
Japanese Patent Office		

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

	& US, A, 4564678 & GB, A, 2131423	
A	Chemical Abstracts, Vol. 107, No. 15 (1987) Abstract No. 126971j	1-5, 7
A	Chemical Abstracts, Vol. 106, No. 17 (1987) Abstract No. 131605f	1-5, 7
A	Chemical Abstracts, Vol. 104, No. 15 (1986) Abstract No. 122851q	1-5, 7
A	Chemical Abstracts, Vol. 110, No. 9 (1988) Abstract No. 68960h	1-5, 7

V. ☒ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☒ Claim numbers 6, because they relate to subject matter not required to be searched by this Authority, namely:

Claim 6 of the present application pertains to a medical treatment of the human body by curing.

2. ☐ Claim numbers, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers, because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.